SUSTAINABLE DEVELOPMENT AND SUSTAINABLE INCOME FROM ALASKA'S RESOURCES

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November 2003

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Understanding Alaska (UA) is a special series of ISER research studies examining Alaska economic development issues. The studies are funded by the University of Alaska Foundation.
This and other UA reports are on the project web site– www.alaskaneconomy.uaa.alaska.edu

Sustainable Development and Sustainable Income from Alaska's Resources

Abstract

I consider the definition and measurement of sustainable development for a resource-rich region such as Alaska, reviewing the evolution of so-called green accounting and discussing appropriate applications to small open regional economies. I then investigate how much of the rapid economic growth Alaska experienced in the three decades following passage of the Alaska Native Claims Settlement Act (ANCSA) constituted sustainable development. Estimates of sustainable income suggest that even after adjusting for depletion of non-renewable resources, the state's economy was nearly three times larger at the end of the 1990s than it had been in 1971. Although oil assets declined, tourism, air cargo, and other sustainable industries grew, as did income from state savings accounts set aside from petroleum revenues. Despite the growth of Native corporations created under ANCSA, the locally controlled portion of Alaska's economy continues to decline.

Keywords: national income accounting, sustainability, natural resources, regional development, Alaska.

Suggested running head: Sustainable Development in Alaska

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Introduction

Resolution of land claims with the Alaska Native Claims Settlement Act (ANCSA) in 1971 accelerated resource development in the state, leading to an era of unprecedented economic expansion. Did this economic growth embody sustainable development of the regional economy, or did it amount to little more than a one-time liquidation of natural resource assets? Answering this question requires defining sustainable development for regions, and perhaps more importantly, a method to measure progress toward sustainability. A growing international effort works toward institutionalizing definition and measurement of sustainable development at the national level. In this paper I discuss methods and results of applying such methods to the state of Alaska, a remote northern resource-dependent economy.

I begin with a brief overview of how the term sustainable development may inform history and policy of northern and resource-dependent regions such as Alaska. So-called *green accounting* has evolved as an international collaboration to develop methods to define and measure sustainable development by making revisions and additions to standard economic accounts. I summarize major programs to implement green accounting and discuss several methodological issues relevant to applying such methods to a small open economy in the age of globalization. Then, I present preliminary estimates of sustainable income for the state of Alaska, analyzing the contribution of sustainable industries relative to the Permanent Fund and other state savings accounts set aside from petroleum income. Finally, I consider the status in contemporary Alaska of other conditions that have been suggested as important for sustainable development that are not included in the sustainable income measures. While my emphasis is clearly on practical methods for defining and measuring sustainability for a particular region, the principles developed here apply globally.

Sustainable Development of Regions

In this section I first examine what people mean when they talk about sustainable development. Then I place the salient issues in the Alaska context.

What is sustainable development?

Pretes and Robinson (1989) review the history of the concept of sustainable development, tracing its origins to Gandhi's views on community development and self-reliance. In the literature on sustainable development, the term has meant variously a set of outcomes for society, a set of policy goals, and a set of policy prescriptions. The Brundtland Commission (World Commission on Environment and Development, 1987) developed the most commonly cited outcomes-based meaning: economic development is sustainable if it meets the needs of the present generation without diminishing the ability of future generations to meet their own needs. This definition is very broad, and it has been widely used by international agencies and non-governmental organizations (SEEA, 2003; Fri, 1991).

Because sustainable development has from the first been linked to development policy, the concept is often tied directly to a set of policy goals. The United Nations Development Programme (UNDP) *Human Development Report, 1992* (UNDP, 1992) articulated a thorough and inclusive set of ten policy goals for achieving sustainable development. In addition to environmental goals, they include social goals of eliminating poverty, reducing population growth, distributing resources more equitably, and expanding health and educational opportunities. Like much of the literature on sustainable development, the 1992 and subsequent UNDP reports, along with the related Millennium Declaration (UNDP, 2003), confound outcomes with the means for achieving them. For example, the 1992 UNDP goals also include a decentralized, more participatory government, more equitable trading systems, increased production for local consumption (self-sufficiency), and locally adapted solutions to environmental problems.

The 1992 and subsequent UNDP reports remain quite vague about how the stated goals will achieve the Brundtland Commission definition of sustainable development, to which the

UNDP also subscribes.[i] The reader is left with the understanding that sustainable development is "a *process* in which economic, fiscal, trade, energy, agricultural, and industrial policies are all *designed* to bring about development that is economically, socially and ecologically sustainable." (UNDP, 1992, p. 17, emphasis mine) Several goals suggest that sustainable development requires not only the strengthening of local institutions but the replacement of production for export with production for local consumption. Linking sustainability to community self-reliance is common in the social science literature (see Pretes and Robinson 1989), but its relation to the Brundtland Commission's definition is indirect. The concept of sustainable development can be viewed as the raising of consciousness about the relationship between economic activity, communities, and the land. The strengthening of local communities is assumed to foster stewardship of the surrounding landscape.[ii]

Daly (1990) discusses three classes of sustainable economic outcomes that have been suggested over the years. The basic measure, which he calls *weak sustainability*, is that of Hicksian income. Hicksian income is the maximum amount one can consume over a given period, without drawing down the value of the capital stock of natural and man-made resources.

Daly notes that most economists do not concern themselves even with weak sustainability because they believe the economy creates new technologies, products, and opportunities to replace natural assets that may be lost. For this view, he defines *very weak sustainability*: the capability of the economy to maintain a non-declining level of utility, or Hicksian welfare.[iii] Under very weak sustainability, communities and regions have no role except as transitory sites of economic opportunity. Daly's *strong sustainability* criterion requires that natural and the physical capital stocks separately be left intact. He suggests that sustainable development requires each project (in each place) to meet the standards for strong sustainability. Projects that deplete non-renewable resources should only be undertaken in conjunction with complementary projects that invest the proceeds in renewable activities.

Daly implies that differences between the measures of weak and strong sustainability correspond to differences in accounting for changes in the capital stock. The degree of

disaggregation for assuring that the capital stock has not been depleted increases with the "strength" of sustainability. A weak measure holds that the sum of the values of natural resources and physical capital stock are maintained. A stronger measure requires that each be maintained separately. The UNDP goes farther, requiring that human capital as well as ecological integrity and physical assets should be maintained.[iv] Others go farther still, suggesting that natural, social, and physical capital be maintained in each place.

Sustainable development for Alaska and other northern regions

Patrick Dubbs (1992) describes the goals of sustainable development for rural Alaska as providing individuals with opportunities for "lasting and secure livelihoods that minimize resource depletion, environmental degradation, cultural disruption, and social instability." Arctic traditional societies reproduced themselves for generations as largely autonomous and self-sufficient economies. The incentives these societies offered for economic behavior were locally efficient and stable: what was best for the individual was best for society over many generations. Although individuals in these societies can realize a much higher level of material well-being today by integrating into the modern market economy and accepting financial assistance from central governments, this new wealth is controlled from distant capitals and may be transitory. What is best for some individuals -- the young and mobile, may be to convert resource endowments into cash. But what is best for these individuals is not best for the communities—that is, those who remain.

At the regional level, sustainable development for northern and remote areas still presents some special concerns. Most important is that remote regions are particularly vulnerable to boom and bust conditions caused by fluctuating world prices for resources and shifting policies formulated in remote political and economic centers (Huskey and Morehouse, 1992). As Pretes and Robinson (1989) note, the economic dependence of small, remote areas reduces the likelihood that local economies will be sustainable.

In summary, an entrenched intellectual tradition links decentralization of political and economic power and local self-sufficiency to the concept of sustainable development. These

local and regional goals cannot be tied directly to individual or collective well-being. However, proponents of sustainable development believe that the former is a prerequisite for the latter. This implies a revision of the Brundtland Commission definition of sustainability to:

> Sustainable regional development meets the needs of the present generation *of residents* without compromising the ability of future generations *of residents* to meet their own needs.

This new definition goes beyond Daly's strong sustainability criterion so as to include the main human development goals satisfied at the regional and possibly local level.

Accounting for Sustainable Regional Development

National Income Accounting and green accounting

Over 60 years ago, economists at the National Bureau of Economic Research developed methods of national income accounting to describe the aggregate production level of a market economy, or Gross Product (GP) (Kuznets 1954). The two principal definitions of aggregate economic activity are the Gross Domestic Product (GDP) and the Gross National Product (GNP). GDP measures the total market value of goods and services produced within the boundaries of a nation. GNP measures the total contribution to global production by residents of the nation—which corresponds in a market economy to total income received by national residents. GNP and GDP measure production of sectors or regions of the economy in terms of value added: the difference between the market value of production and the purchases of inputs from other sectors or regions. Net Domestic Product (NDP) and its counterpart, Net National Product (NNP), adjust GDP and GNP respectively by subtracting depreciation of the capital stock.

Over the years, a number of critics have raised fundamental questions about GP as a valid measures of economic activity. Most of the principal objections follow from the fact that national income accounting includes only economic activity traded through markets. Missing from the accounts are subsistence, household production, environmental effects such as

pollution, and large portions of the informal economy. A related problem with GP as a historical measure of economic change is that long-term increase in the share of economic activity that has been drawn into the market sector causes a spurious rise in measured per-capita output. Because more of women's work worldwide takes place in the household and informal sectors, GP systematically undervalues the contributions of women (Waring, 1988). Despite its shortcomings, national income accounting has stood the test of time and is firmly entrenched as a standard tool for measuring economic performance.

A growing intellectual movement, often called *green accounting*, seeks to address the main criticisms of national income accounting through reforms ranging from modest to radical. Specific initiatives to implement green accounting fall generally into two camps: those that seek to correct errors and omissions in standard GP measures, and those that quantify important social outcomes that aggregate value added measures cannot address.

One can identify four stages in green accounting as it has evolved over the past two decades. The first and most basic stage adjusts GP to account for depletion of natural resources. Two primary approaches to making these adjustments have been suggested: the *depreciation method* and the *user-cost method*. The depreciation method treats depletable natural resources like physical assets, adding investment when natural assets grow or are developed, and subtracting depreciation as the resources are used up (Landefeld and Hines 1985, Repetto et al. 1989). The Integrated Environmental and Economic Satellite Accounts (IEESA) implements this approach for the United States economy (Landefeld and Carson, 1994). The user-cost method, developed by El Serafy (1989), derives from the concept of a sinking fund charge for depletion (Stauffer, 1984). It considers as income only the amount of non-renewable production value that could be sustained in perpetuity that value were reinvested in reproducible assets. While somewhat more difficult to compute, the user-cost method more closely corresponds to the concept of Hicksian income (Daly and Cobb, 1989).

A second stage of green accounting attempts to value the direct contribution of the environment to production and income: ecosystem services add value, pollution subtracts value.

A third level reform expands the calculation of values to non-market environmental amenities. The National Research Council recommended continuing to refine methods for the valuing the environment so that the IEESA could implement stages two and three of green accounting in the US (NRC, 1999). The United Nations' System of integrated Environmental and Economic Accounting (SEEA) provides a framework to institutionalize stages one through three of green accounting throughout the world. The SEEA comprises three categories of satellite accounts: (1) flow accounts for pollution, energy and materials, and (2) expenditures for environmental protection and resource management (so-called *defensive expenditures*), as well as (3) natural resource asset accounts (SEEA, 2003).

The fourth stage of green accounting adds the contribution of non-market household production and quantifies the distribution of value to distinct groups of people. Only at this final level does green accounting address the full aspirations of sustainable development. The System of Economic and Social Accounting Matrices and Extensions (SESAME) is an accounting framework started in the Netherlands that implements the fourth stage of green accounting. It integrates economic and social indicators with a modified input-output table to track pollution through the economy, so that one may identify relationships among household groups and their contribution to polluting or sustainable output (Keuning, 1996).

Green accounting at the regional level

One can apply national income accounting principles to any region to obtain the analogous measures of the aggregate regional economy -- *Gross Regional Product (GRP)* -- using the rules for estimating either GDP or GNP for nations. The experience of green accounting suggests that several adjustments to GRP would appropriately address sustainable development for a region such as Alaska. Of course, there is the basic (first-stage) adjustment of natural resource production to exclude depletion of the resource stock. Foy (1991), and Berman et al. (1992) describe examples of revisions in gross product for the oil and gas sectors of Louisiana and Alaska, respectively, using both depreciation and user-cost methods. A number of additional adjustments might be appropriate, however.

First, temporary world price fluctuations for resources provide misleading signals about the value of production. Second, non-resource activity that supports and is supported by unsustainable resource production should also be excluded.[v] A third adjustment might consider the value of household production of subsistence products in the mixed economy of rural Alaska (Wolfe et al., 1984). Fourth, ecosystem services and other non-market environmental values are quite large in Alaska (Colt, 2001), so changes in these values may significantly affect opportunities for future generations of residents. Finally, the goal of decentralization of economic and political power often included in visions of sustainable development suggest a measure of income or product that is produced by and for regional residents.

Not all these adjustments are feasible and practical for subnational regions, due to data limitations. Here are some suggested accounting measures and methods.

Sustainable Regional Product. Sustainable Regional Product (SRP) adjusts GRP to exclude depletion of resources and spending attributed to depletion, while including subsistence production and non-market values of ecosystem services to the extent that reliable methods are available to estimate them. Estimating SRP requires overcoming several methodological challenges.

To begin with, there is the problem of how to adjust rents from natural resource production to account for depletion. How natural resource exploitation contributes in the long run to changes in income depends, of course, on whether the current proceeds are consumed or invested, and at what rate of return. Investment trusts and development trusts (Robinson, et al., 1989) provide vehicles for this reinvestment.[vi] Most economists assume that the asset value of a natural resource deposit is equivalent to the present value of the economic rent: the market value of production exceeding the cost of labor and capital invested in producing it. Berman et al. (1992) argue, however, that in a small remote region, perhaps the entire value added—rents, taxes, wages, and profits—should be counted as a depletable asset. This is because the labor and capital may have no alternative employment in the region at the rates paid by the resource industry. In global capital markets, the opportunity return to capital reflects opportunities

worldwide. The next best investment in any region—or even nation—may have a much lower rate of return than the next best investment elsewhere in the world. If labor is mobile among regions, the wage likewise does not reflect the regional opportunity cost.

Next, one needs to adjust support sector production so that it measures the amount of support activity that would take place if the resource industries were operating at sustainable levels. I propose to make this adjustment by applying regional multipliers to the difference between total and sustainable value added for resource industries. The appendix discusses how to calculate such a multiplier.

Finally, one faces the problem of how to value subsistence activities. Placing a dollar value on subsistence is a controversial endeavor, and deservedly so. It would be absurd to claim that such a market value can reflect the option of future generations to engage in a subsistence way of life, much less the preservation of a community or the continuation of a culture. On the other hand, ignoring subsistence causes us to underestimate its contribution to the material welfare of the rural population. Even if one ignores the broader issues, can one reliably and fairly estimate the value-added equivalent —the imputed income—derived from subsistence?

Economists have developed two parallel methods for calculating value added in gross product accounts: market value and imputed factor cost. The market value method would impute a value of subsistence activities at the replacement cost of the food and other goods and services provided by subsistence participants. The factor cost method measures wages and rents that subsistence participants could earn from employing their labor and equipment in market activities.[vii] The factor cost method captures to a greater extent the well-being people derive from participating in subsistence activities; it assumes that participants choose to retain a subsistence lifestyle rather than moving to a place where jobs are plentiful. Although the factor cost method generates a result that can be applied consistently within and across regions, the values it generates are nevertheless speculative and should be viewed with caution.

Sustainable Permanent Gross Regional Product (SPRP). SPRP adjusts SRP to remove the effects of temporary fluctuations in world markets for resources and natural fluctuations in resource harvests. Such adjustments may be to revise SRP downward (due to a temporary boom) or upward (temporary crash). Such adjustments must be careful to avoid confusing temporary fluctuations (for example, oil prices since 1986) with long-term shifts (prices for wild salmon reacting to the introduction of farmed salmon). The appropriate method is one that most closely represents production and prices that typically would occur in a normal or average year. Each resource industry must be adjusted individually, since fluctuations in one resource do not necessarily coincide with fluctuations in another.[viii]

Sustainable Permanent Locally-Controlled Gross Regional Product (SPLRP). To achieve fully the vision of the sustainable development for a region, one should count only that income or product that is produced by and for regional residents. Although many advocates of sustainable development promote self-sufficiency as a goal, practically no economic activity can satisfy that criterion in a small regional economy. Even subsistence activities require purchases of market inputs with cash—which is often provided either directly or indirectly from production for export or from out-of-region governments.

A strict measure of SPLRP is therefore not likely to be very useful. A more modest proposal might be to count income as locally controlled if local residents or governments control the production process that generates that income. No method of determining control of the production process is free of ambiguity, nor can any be universally applied with good results. The best method is one that incorporates a thorough understanding of the local political economy. The guidelines in Table 1 illustrate how one might determine local versus external control of production and income.

All these measures of sustainable development outcomes ignore a number of issues raised as policy goals of sustainable development as discussed above. For example, the sustainable income estimates do not adjust for potential depreciation of human capital, nor do they address equity within the region. It is probably best that no attempt be made to incorporate

such issues into the measure of gross income, since the relative weights of ecological and humanistic concerns in a regional income account would be entirely arbitrary. In the next section, I apply these principles to measure sustainable economic outcomes for the state of Alaska. The same procedures may be applied with equal validity to regions of the state or even to individual communities, provided the necessary data exist.

Measuring Sustainable Economic Outcomes for Alaska

Alaska has a population of about 630,000 (US Census, 2000), with about half the residents living in or near the regional commercial center of Anchorage. Although petroleum is the largest industry—as measured by contribution to value added—the economy is relatively diversified, with fishing, federal government, externally provided transfers, forest products, and tourism all providing a significant economic base. For the state as a whole, government spending of oil revenues is a support activity, since it is derived from taxation and lease payments from local industry and spent to meet local demands.

Sustainable and Unsustainable Gross Regional Product

Table 2 shows estimates of total and sustainable value added in the Alaska petroleum industry over the period 1965-1998, using the approach discussed in Berman et al. (1992), updated to 1998. These estimates correspond to the domestic product—the amount produced in Alaska during each calendar year—for oil and gas extraction, transportation, and processing.

Figure 1 illustrates how Alaska petroleum Regional Product differs, depending on the definition of value added.[ix] Under the depreciation method, petroleum sustainable value added using shows a huge, one-time spike in 1977—the year oil started flowing through the trans-Alaska pipeline—indicating the creation of wealth from the Prudhoe Bay reserves. Conventional value added peaked in 1981 at about $27.5 billion (in 1998 dollars), declining to about one-fifth that level by 1998. Net sustainable product calculated with the user-cost method peaked at $12.6 billion in 1979, then declined much more slowly to about $4 billion in 1998, as the asset value of remaining oil in the ground gradually declined.

Oil market fluctuations have less direct impact on sustainable value added computed by the user-cost method than on value added computed by the other methods. User-cost sustainable gross product even exceeded conventional value added when oil prices crashed in 1986 and 1998.

The petroleum industry is the main non-renewable resource industry that generates unsustainable value added in Alaska. Although the Alaska forest harvests may be technically sustainable in terms of biomass production, the forest products industry relies heavily on unsustainable harvests of high-value old-growth stands that are rapidly being depleted. Figure 2 shows estimates of conventional and sustainable value added, computed with the user-cost method in the forest products industry. Fluctuations in conventional value added follow fluctuations in markets for forest products and logging activity on lands awarded Native corporations under the 1971 Alaska Native Claims Settlement Act. The sustainable value added calculations generously assume that the value added (adjusted for inflation) by the forest products industry in 1961, when one large pulp mill was operating, can continue indefinitely.[x]

Table 3 shows the estimated Sustainable Gross Regional Product (SGRP) by industry, from 1961 through 1998, adjusted for inflation and expressed in 1998 prices. Gross Regional Product for all industries except petroleum and forest products are taken from Goldsmith (2000), using methods described in Larson et al., (1991).[xi] Sustainable Gross Product figures for petroleum and forest products are derived with the user-cost method. I used a seven-percent real rate of return to compute the capitalized value of the income stream and the annual user cost from unsustainable natural resource production. An appendix provides precise definitions and technical notes on measurement methods.

Figure 3 compares sustainable and unsustainable Gross Product for Alaska over the past three decades. SGRP rose sharply as North Slope oil fields began production in the late 1970s. SGRP remained at about $30 billion dollars during the period 1979-1983 and then began declining gradually until leveling off at about $22 billion in 1995. During the peak year of conventional oil value in 1981, SGRP amounted to about two-thirds of total GRP. While

unsustainable petroleum value added constituted most of the difference between GRP and SGRP, other industries also contributed to unsustainable production. Following Berman et al., (1992), I assume that the portion of value added by state and local government financed directly from petroleum revenues was depletable and subject to the user-cost recalculation. Except during construction of the trans-Alaska pipeline in the mid-1970s, the unsustainable component of support sector value added is relatively small. The adjustment is modest because the calculated multiplier on petroleum value added (see appendix) is very low—that is, most petroleum sector value added not captured in state revenues is exported out of state. The large government component of SGRP includes all federal civilian and military spending in Alaska, which also may not all be sustainable in the long run.

After the peak in 1981, both sustainable and total GRP declined, but sustainable product declined more slowly. The reason that the sustainable product numbers did not decline faster is due in part to the fact Alaska created a Permanent Fund, which has received a share of petroleum lease payments since North Slope production began. By 2000, the balance in the Permanent Fund and other state savings accounts had risen to $30 billion. A portion (currently, about one-half) of Permanent Fund earnings is paid in dividends to state residents, adding about $1 billion annually to SGRP.

The GRP and SRP totals in Figure 1 do not include values for subsistence production or other ecosystem services. Adding a value for subsistence to the graph would make little discernible difference, despite its significance locally in rural Alaska. Using the factor-cost method, I estimate of the value of Alaska’s subsistence sector might be about $320 million, in 1998 dollars. I derive this estimate by multiplying the number of Alaska households that a 1985 survey (McDowell Group 1985) estimated got at least one-fourth of their total food consumption from subsistence—about 38,000 households—by one-fourth the average annual real earnings per employee in Alaska in 1998. This assumes that subsistence participation has remained constant since 1985, which is probably realistic. By this calculation, subsistence adds about 1.5 percent to Alaska's Sustainable Gross Product.

Colt (2001), building on Larson (1988) provided rough estimates of the value of ecosystem services in Alaska. He estimated that sport hunters and anglers received a value of $240 million in willingness-to-pay (WTP) for opportunities in Alaska, in addition to the approximately $300 million in spending already included in SGRP in Table 3. Similar values for Alaska wildlands totaled at least $300 million, but with a wide margin of error. Figures for such ecosystem services as climate control through carbon sequestration are even more speculative. While the amount all these ecosystem services combined would add to SGRP is quite substantial, insufficient information exists to measure changes over time. Their effects on sustainable development in Alaska are therefore impossible to quantify.

Sustainable Permanent and Locally Controlled Regional Product

The petroleum sector so dominates Alaska's economy that the effects of smoothing out market fluctuations in renewable resource industries such as fishing are relatively minor. A graph of Sustainable Permanent Regional Product for Alaska would look practically indistinguishable from Sustainable Regional Product calculated with the user-cost method (shown in Figure 1). To illustrate this point, I show in Figure 4 conventional value added in fisheries and an adjustment to Sustainable Permanent Product. I fit a third-order polynomial to smooth short-term fluctuations in fisheries markets and harvests. The Permanent Gross Product curve shows a long-term rise from the 1970s to around 1990, as salmon fisheries recovered from historic low harvests, the US asserted jurisdiction over offshore fisheries, and markets for seafood products strengthened. Since 1991, the permanent value added has declined, reflecting the long-term market effects of farmed salmon production. The difference between conventional and permanent fisheries value added is often as large as $200 million annually, or about 20 percent of the conventional total.

Obtaining reliable estimates of Sustainable Permanent Locally Controlled Regional Product (SPLRP) for an economy as large as the state of Alaska's would take a great deal of research and is beyond the scope of this article. A rough estimate might show SPLRP at half the level of Sustainable Regional Product. I obtain this estimate by assuming that 25 percent of

the petroleum industry—the approximate share received by the state for both its taxing and landowning roles—was locally controlled, as well as all state and local government, around half the other resource industries, and varying shares of support sector industries.

Native corporations formed under ANCSA provide a vehicle for achieving the objective of locally controlled economic activity. While some corporations have been highly successful as business ventures, their growth has made little difference in share of locally controlled production. Regional and village corporations receiving extensive timber lands contributed as much as one-half of value added in the forest products sector over the past two decades, but little of this Gross Product is sustainable. Corporations without natural resource endowments invested their land settlement cash to purchase or displace other locally controlled businesses in ecotourism industries, retailing, and services. Joint ventures in mineral development, major hotel chains, fishing, and oil companies share control with multinational corporations. However, many of the most successful ventures have come when native corporations invested in operations outside Alaska. So while Native Corporations have contributed to locally controlled production in specific instances in some regions, their impact at the state level has been minor.

Although the SPLRP percent of SRP fluctuates somewhat over time as the industry composition changes, it has generally trended downward. Over the past twenty years, national and multinational corporations have increased their stake in Alaska's growing (sustainable) retailing, financial, and air transportation industries. The Alaska, Native corporations and multinational corporations alike have been riding the wave of globalization.

Conclusion

The methods developed by economists to measure sustainable national income lend themselves readily to measurement of sustainable income at the regional level. Sustainable income is one important indicator of sustainable development. No matter how we define sustainable income for Alaska, the state's economy increased four to five-fold between 1961 and the end of the 1990s. The increase all took place prior to 1980. During the 1980s and the first half of the 1990s, depletion of oil assets exceeded the returns on investing oil revenues and the growth of other sustainable activities combined. In the late 1990s, growth of tourism, air cargo, and other sustainable industries—combined with income from state savings accounts—began to cancel out the decline in the petroleum sector. Most value added in Alaska is now sustainable, although the amount of sustainable value added that can reasonably be declared "locally controlled" continues to decline.

Appendix: Technical notes

Definition of accounting measures

First let me define some terms and symbols pertaining to production and income in the regional economy as follows:

Definition of terms and symbols

T Transfers flowing into the region net of personal taxes flowing out

N Value added in non-renewable export industries

R Value added in renewable export industries

S Support sector value added (all market economy for local consumption)

I Investment trust balance -- invested in out-of-region capital market

i Real rate of return on investment trust balance

r Real rate of return on development trust balance

π Net factor payments flowing out of region (assume all from N, R)

Gross Regional Product. Gross Regional Product (GRP) may be measured either under the rules for estimating Gross Domestic Product (GDP) or under the rules for estimating Gross National Product (GNP) for nations:

$$GRP_D = N + R + S; \quad (1)$$

$$GRP_N = N + R + S + T - \pi + iI. \quad (2)$$

Sustainable Gross Regional Product (SRP). Using the superscript S to signify adjustments for sustainability, one can write:

$$SRP_D = N^S + R^S + S^S + L; \quad (3)$$

$$SRP_N = N^S + R^S + S^S + T - \pi^S + iI + L \quad (4)$$

Measurement methods

Adjusting nonresident factor payments. One should adjust payments to nonresidents from resource production so as not to make too large a correction in the SRP_N. The residence adjustment, π, should be adjusted in each of these steps so as to maintain the ratio

$$\pi^S/(R^S+N^S) = \pi/(R+N).$$

Adjusting the support sector. The simplest way to remove from support sector production S the effects of unsustainable resource production is to apply a regional multiplier to the difference between gross resource product and sustainable resource sector product. In economic base models, the regional multiplier m for the change in support activity with a change in resource export activity is usually defined as follows.

$$m_D = S/(N+R) = S/(GRP_D-S). \quad (5)$$

Note that the subscript, D, is added to m because it is calculated from the domestic product definition of GRP. An alternate method is to use the GNP definition:

$$m_N = S/(N+R-\pi+iI+T) = S/(GRP_N-S). \quad (6)$$

One must accurately measure N and R to include only rents and taxes accruing to regional residents or governments; otherwise the multipliers calculated with these formulas will be far too high. If $T + iI$ differs substantially from π, the GDP multiplier is likely to be inaccurate. Therefore, I suggest that one use the income multiplier.[xii] The adjustment in support industry is therefore calculated as follows:

$$S^S = S - m_N[N + R - (N^S + R^S)]. \quad (7)$$

The same multipliers can be used to adjust the support sector for SPRP and SPLRP.

If the rate of return on the development trust, r, earns a lower rate of return than the investment trust, one should technically use r rather than the presumably higher world market rate, i to calculate N^S (the interest on the present value of resource production). One should

still use the world rate, *i*, however, to compute the present value itself, since the opportunity cost of capital invested in resource development is typically a world rate of return.

Calculating income multipliers for Alaska. Regional multipliers used for adjusting Alaska support sector gross product to sustainable levels use the following modification to equation (5). I first divide the support sector into two categories: infrastructure -- construction, transportation, and utilities (except pipeline construction) -- and trade and services. I assume that petroleum gross product may have a different multiplier from that of other "basic" industries, due to the high proportion of oil market value exported directly from the state. The multiplier was defined as a weighted average of two multipliers -- one for petroleum and the other for all other goods -- as follows:

$$m_D = [m_1 P + m_2(N+R-P)]/(N+R), \quad (8)$$

where P represents petroleum sector gross product. The two multipliers are estimated from the following regression equation estimated from data in Goldsmith (2000):

$$S = m_1 P + m_2(N+R-P) \quad (9)$$

The equation results were as follows:

	Infrastructure		*Trade and Services*	
	Coefficient	*t Stat*	*Coefficient*	*t Stat*
Intercept	690.965	2.24339	-1398.2	-3.2863
m_1	0.07004	5.64864	0.06923	4.04179
m_2	0.30543	3.61956	1.24345	10.6675
R Square	0.71755		0.8704	
Standard Error of Regression	532.926		736.17	
Observations	38		38	

Endnotes

[i]The UNDP measures sustainable development with the Human Development Index, which contains three equally weighted components: per-capita GDP, education, and life expectancy (United Nations Development Programme 2003).

[ii]As writer Wendell Berry put it, “It won’t do to correct mistakes made in one place by moving to another place, as has been the common fashion in America, or by adding on another place, as is the fashion in any sort of ‘growth economy’” (Berry, 1988, p. 48).

[iii]For example, if a species or culture becomes extinct, we have zoos, museums, and television to bring the remaining creatures and peoples much closer to us, leaving us possibly better off.

[iv]"Investment must be made in the health and education of today’s population so as not to create a social debt for future generations. And natural resources must be used in ways that do not create ecological debts by overexploiting the carrying and productive capacity of the earth." (UNDP 1992, p. 17)

[v]Neither of these two problems arises in a large national economy, where the exchange rates, domestic prices, and aggregate demand management reallocate the effects of these changes to other industries. But in a small, open, regional economy, these reallocations to other industries are likely to shift production to other regions. For example, if temporarily higher oil prices cause a surge in spending nationally on oil drilling, the additional resources (labor, capital) for that spending come from reallocation of spending elsewhere in the economy, but not necessarily from within the region where the oil drilling takes place.

[vi]SRP is only *potentially* sustainable; it represents the amount of current production that *can* be sustained indefinitely. Whether it *is* sustained in practice depends on the disposition of the non-sustainable production. For sustainability to be achieved in practice, this entire amount must be deposited into a permanent trust fund that earns a rate of return equal to the interest rate on the asset value of natural resource production. If the goal is sustainable income for residents of the region, then earnings from an investment trust—invested outside the region—help achieve

sustainability. If the goal is to achieve sustainable regional production, then only the amount deposited in a development trust—invested within the region—will help.

[vii]When markets allocate labor and capital to industries producing products for the market, the two methods reach identical conclusions. But with subsistence and other non-market economic activities, results from the two methods may differ substantially.

[viii]Note, however, that for depletable resources, the user-cost method already smoothes much year-to-year price fluctuations by calculating production as a fixed percentage of a long-term income stream.

[ix]The depreciation method adjusts Net Domestic Product. While the depreciation method perhaps provides a better measure of sustainable resource *production*, the user-cost method better measures sustainable *income* from non-renewable and renewable but depletable resource industries. It measures the sustainable income from resource production as the interest on the expected present value of future resource value added. The user-cost method measures Gross Product; one subtracts depreciation of physical assets to obtain Net Product.

[x]At this writing, both Alaska pulp mills that operated throughout most of the period 1961-98 have closed, with a new fiberboard plant that would create less valued added than one of the former pulps mill on indefinite hold due to lack of financing.

[xi]The figures for all industries and sectors are adjusted for inflation with the US GDP deflator. They therefore differ from the figures published in Goldsmith (2000) and Larson (1999), which adjust each industry separately with its own deflator. The latter procedure may provide a more accurate picture of physical production over time. However, the latter provides a more revealing accounting of income over time.

[xii]See Berman and Hull (1987) for a discussion of the advantages of income (GNP-based) multiplier for small regions, along with examples of calculations of regional income multipliers for several regions of Alaska.

References

Berman, M., Larson, E., Tuck, B., 1992. Natural resource depletion and social income accounting: Sustainable income in petroleum-dependent economies. *OPEC Review*, Winter 1992 Supplement.

Berman, M., Hull, T., 1987. *The Commercial Fishing Industry in Alaska's Economy*, Institute of Social and Economic Research, University of Alaska Anchorage, March.

Berry, W., 1988. People, land, and community, in *Standing by Words: Essays*, (North Point Press, 1983), reprinted in eds. Simonson, R., Walker, S., *The Graywolf Annual Five: Multicultural Literacy*, Saint Paul: Graywolf Press.

Colt, S., 2001. *Economic Importance of Healthy Alaska Ecosystems*. Institute of Social and Economic Research, January.

Daly, H.E., and Cobb, J.B., Jr., 1989. *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future.* Boston: Beacon Press.

Daly, H., 1990. Sustainable development: from concept and theory toward operational principles, in *Steady State Economics*, 2nd ed., Washington, D.C.: Island Press, 241-260.

Dubbs, P., 1992. Sustainable development and indigenous people: Authors and actors in rural Alaska. Paper presented to the Western Regional Science Association, Lake Tahoe, California, February 1992. Available on the internet at http://www.ankn.uaf.edu/susdev.html.

El Serafy, S., 1989. The proper calculation of income from depletable natural resources, in eds. Ahmad, Y., El Serafy, S., Lutz, E., *Environmental Accounting for Sustainable Development*. World Bank, Washington, D.C., 10-18.

Foy, G., 1991. Accounting for non-renewable natural resources in Louisiana's Gross State Product. *Ecological Economics* 3:25-41.

Fri, R.W., 1991. Sustainable development: Principles into practice.” *Resources* 102 (Winter):1-3.

Goldsmith, S., 2000. The Alaska economic database: Charting four decades of change. ISER Working Paper 00.1, February.

Huskey, L., Morehouse, T., 1992. Development in remote regions: What do we know?" *Arctic*, 45: 128-137.

Keuning, S.J., 1996. *Accounting for Economic Development and Social Change*. Amsterdam: IOS Press.

Kuznets, S., 1954. *National Income and Its Composition, 1919-1938*. New York: National Bureau of Economic Research.

Landefeld, S., and Carlson, C., 1994. Integrated Environmental and Economic Satellite Accounts. *Survey of Current Business* 74(4):33-49.

Landefeld, S., Hines, J., 1985. National accounting for non-renewable natural resources in the mining industries,” *Review of Income and Wealth* 31(1), 1-20.

Larson, E., 1999. Alaska sustainable Gross State Product. Paper presented at *Can the Last Frontier Have A Sustainable Future?* Conference, Anchorage, Alaska, July.

Larson, E., 1998. *An Overview of Alaska's Natural Assets*. ISER, December.

Larson, E., Goldsmith, S., Colt, S., 1991. Alaska's Gross State Product, 1961-1990. *Research Summary* No. 52, Institute of Social and Economic Research, December.

McDowell Group, 1985. *Area Cost Differential Study*, Juneau: McDowell Group, April.

National Research Council, 1999. *Nature's Numbers: Expanding the National Economic Accounts to Include the Environment*. eds. Nordhaus, W.E., Kokkelenberg, E.C. Panel on Integrated Environmental and Economic Accounting. Washington, DC: National Academies Press.

Pretes, M, Robinson, M., 1989. Beyond boom and bust: A strategy for sustainable development in the North," *Polar Record* 25 (153):115-120.

Repetto, R., Magrath, W., Wells, M., Beer, C., Rossini, F., 1989. *Wasting Assets: Natural Resources in the National Income Accounts*. World Resources Institute.

Robinson, M., Pretes, M., Wuttunee, W., 1989. Investment strategies for northern cash windfalls: Learning from the Alaskan experience," *Arctic* 42 (3):265-277.

SEEA, 2003. Integrated Environmental and Economic Accounting 2003. Studies in Methods, Handbook of National Accounting, United Nations, European Commission, International Monetary Fund, Organization for Economic Cooperation and Development, World Bank, Final Draft.

Stauffer, T., 1984. Accounting for 'wasting assets': Income measurement for oil and mineral-exporting rentier states. The OPEC Fund for International Development, Pamphlet Series number 25, November.

United Nations Development Programme, 2003. *Human Development Report 2003: Millennium Development Goals, A Compact among Nations to End Human Poverty*. Oxford: Oxford University Press.

United Nations Development Programme, 1992. *Human Development Report*, *1992*. Oxford: Oxford University Press.

Waring, M., 1988. *Counting for Nothing: What Men Value and What Women are Worth.* Wellington, New Zealand: Bridget Williams Books.

Wolfe, R., et al., 1984. *Subsistence Based Economies in Coastal Communities of Southwest Alaska*. Anchorage: U.S. Department of the Interior, Minerals Management Service.

World Commission on Environment and Development, 1987. *Our Common Future*, Oxford: Oxford University Press.

Table 1. Guidelines for Determining Local vs. External Control of Income

Component of Income	Division According To
Wages	Residence of employer
Proprietors' income	Residence of proprietor
Profits	Residence of corporate owners
Taxes and government transfers	Locus of government control
Landowner payments	Residence of landowner

Table 2. Alternative Measures of Petroleum Gross Product

Billion 1998 Dollars

Year	Gross Product (Value added)	Net Product (Value added net of depreciation)	Sustainable Net Product (Depreciation method)	Sustainable Gross Product (User-cost method)	Sustainable Net Product (User-cost method)
1961	0.1	0.1	0.6	0.1	0.1
1962	0.2	0.2	0.1	0.2	0.2
1963	0.2	0.2	0.1	0.2	0.2
1964	0.2	0.2	0.2	0.2	0.2
1965	0.2	0.2	0.1	0.2	0.2
1966	0.2	0.2	0.2	0.2	0.2
1967	0.4	0.4	0.3	0.4	0.4
1968	0.8	0.7	0.7	0.8	0.7
1969	1.0	0.9	8.1	1.0	0.9
1970	1.1	1.0	0.6	1.2	1.1
1971	1.0	0.9	0.7	1.1	1.0
1972	0.9	0.8	0.6	1.1	1.0
1973	0.9	0.8	0.6	1.1	1.0
1974	1.1	1.0	0.8	1.1	1.0
1975	1.2	1.1	0.9	1.1	1.0
1976	1.0	0.9	0.7	1.1	1.0
1977	3.4	2.7	116.4	3.5	2.9
1978	9.3	7.6	6.6	9.8	8.1
1979	15.2	12.3	8.8	15.5	12.6
1980	22.9	18.5	14.3	14.9	10.5
1981	27.3	22.0	16.7	15.3	10.0
1982	23.5	18.9	14.3	15.0	10.4
1983	20.9	16.8	12.8	14.6	10.5
1984	20.4	16.3	12.4	12.1	8.1
1985	20.1	16.2	12.4	11.1	7.2
1986	9.2	7.4	5.7	10.4	8.6
1987	12.8	10.2	7.7	8.7	6.1
1988	10.1	8.0	6.0	8.2	6.2
1989	11.6	9.2	6.8	8.1	5.7
1990	14.0	11.1	8.3	7.8	5.0
1991	10.6	8.3	6.2	7.5	5.3
1992	9.9	7.8	5.7	8.1	6.1
1993	8.0	6.3	4.6	6.5	4.8
1994	7.6	6.0	4.4	5.8	4.2
1995	8.1	6.4	4.8	5.4	3.8
1996	9.4	7.5	5.5	5.2	3.3
1997	7.9	6.3	4.6	5.1	3.5
1998	4.6	3.6	2.7	4.8	3.8

Table 3. Sustainable Alaska Gross Product, User-Cost Method
Billion 1998 Dollars

	Petroleum Extraction and Trans-portation	Forest Products	Other Private Export Industries	Federal Govern-ment	State and Local Govern-ment	Infra-stucture	Trade and Services	Total Support	Total SGRP
1961	0.1	0.1	0.4	1.6	0.3	0.9	1.0	1.9	4.4
1962	0.2	0.1	0.4	1.6	0.3	0.9	1.0	1.9	4.6
1963	0.2	0.1	0.3	1.8	0.4	0.9	1.1	2.0	4.8
1964	0.2	0.1	0.4	1.9	0.4	1.1	1.2	2.3	5.4
1965	0.2	0.2	0.5	1.9	0.5	1.2	1.3	2.6	5.8
1966	0.2	0.2	0.6	1.9	0.5	1.2	1.4	2.6	6.0
1967	0.4	0.2	0.4	2.0	0.6	1.3	1.5	2.8	6.3
1968	0.8	0.2	0.5	1.9	0.6	1.3	1.6	2.9	7.0
1969	1.0	0.2	0.4	2.0	0.3	1.4	1.7	3.1	7.0
1970	1.2	0.2	0.6	2.2	0.8	1.4	1.9	3.3	8.2
1971	1.1	0.2	0.5	2.2	0.9	1.6	2.0	3.5	8.5
1972	1.1	0.2	0.5	2.3	1.1	1.7	2.2	3.8	9.0
1973	1.1	0.2	0.7	2.3	1.1	1.6	2.3	4.0	9.4
1974	1.1	0.3	0.6	2.4	1.2	2.0	2.7	4.7	10.3
1975	1.1	0.3	0.7	2.4	1.5	3.0	4.1	7.1	13.1
1976	1.1	0.3	1.0	2.4	1.6	3.0	4.9	7.9	14.3
1977	3.5	0.2	1.2	2.5	1.7	3.0	4.8	7.8	16.9
1978	9.8	0.2	1.5	2.4	1.7	3.0	4.6	7.7	23.3
1979	15.5	0.2	1.7	2.4	1.6	2.8	4.4	7.3	28.8
1980	14.9	0.2	1.6	2.3	1.5	2.6	4.0	6.6	27.2
1981	15.3	0.2	1.7	2.3	1.1	2.8	4.2	7.0	27.7
1982	15.0	0.2	1.5	2.4	1.7	3.4	4.9	8.3	29.1
1983	14.6	0.2	1.5	2.4	2.2	4.0	5.6	9.6	30.4
1984	12.1	0.2	1.5	2.6	2.3	3.8	5.9	9.8	28.5
1985	11.1	0.2	1.6	2.6	2.5	3.4	6.1	9.5	27.5
1986	10.4	0.2	1.7	2.6	2.8	3.2	6.1	9.3	27.1
1987	8.7	0.3	1.9	2.7	2.5	2.5	5.1	7.6	23.7
1988	8.2	0.3	2.3	2.7	2.4	2.3	5.0	7.4	23.3
1989	8.1	0.2	2.0	2.8	2.4	3.6	5.1	8.7	24.2
1990	7.8	0.2	2.5	2.9	2.3	2.3	5.1	7.4	23.2
1991	7.5	0.2	2.4	2.9	2.4	2.5	5.4	7.8	23.2
1992	8.1	0.2	2.6	3.1	2.6	2.5	5.6	8.1	24.8
1993	6.5	0.2	2.3	3.2	2.7	2.8	5.8	8.5	23.4
1994	5.8	0.2	2.5	2.9	2.7	2.9	5.9	8.9	23.0
1995	5.4	0.2	2.7	2.7	2.7	2.7	5.9	8.7	22.4
1996	5.2	0.2	2.6	2.7	2.5	2.5	5.9	8.4	21.7
1997	5.1	0.2	2.9	2.8	2.4	2.6	6.2	8.8	22.1
1998	4.8	0.1	2.7	2.8	2.5	3.0	6.5	9.5	22.4